Regression Upgrades

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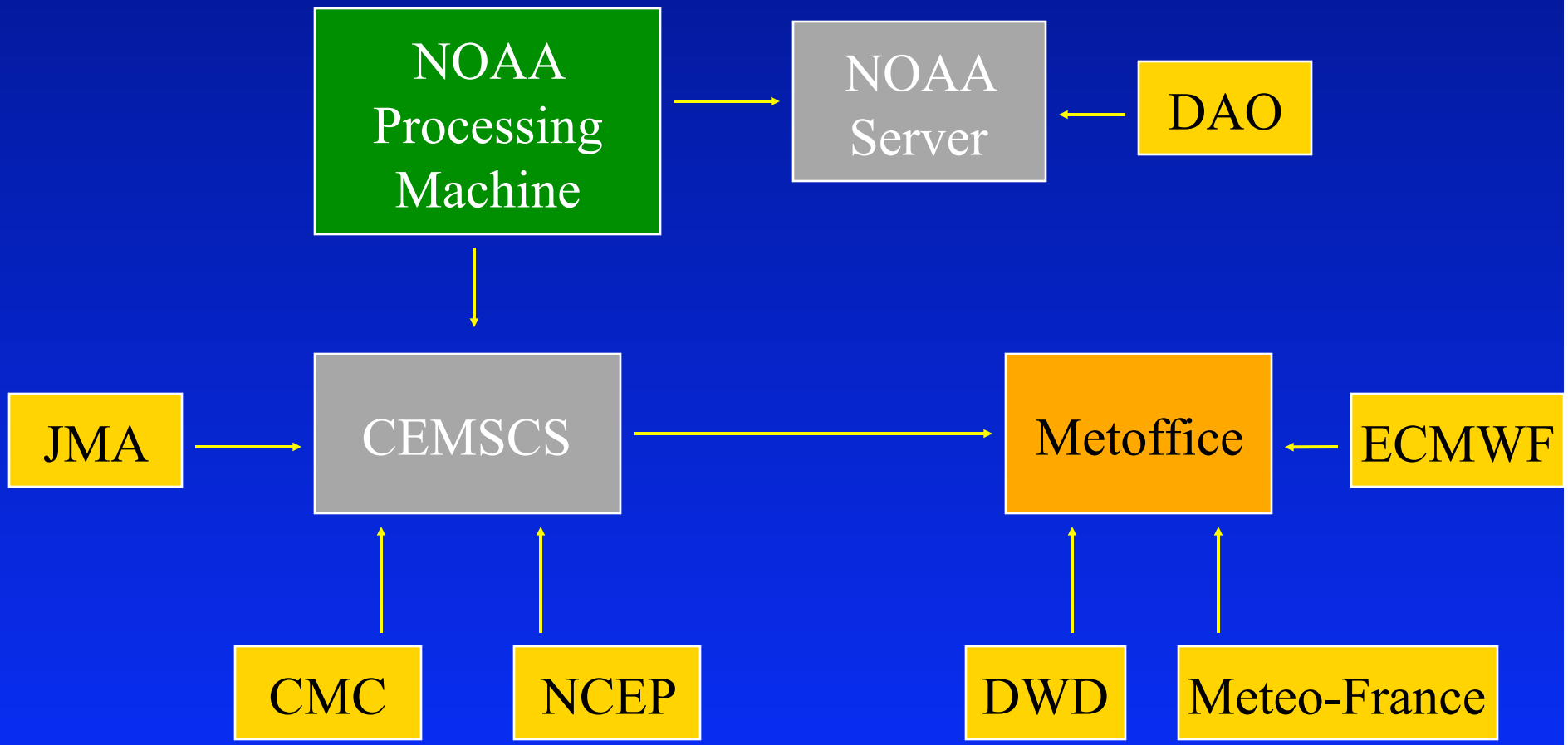
Outline

- Update on Data Distribution
- New data sets to be distributed (includes reconstructed radiances)
- Surface emissivity algorithm upgrade
- Regression retrievals based on collocated raobs

AIRS Update

- AIRS radiance products distributed since October 9, 2002
- Center AIRS fov from every AMSU-A fov is provided.
- 324 channels
- All 3x3 AIRS fov (324 channels) distributed to DAO for internal cloud clearing.
- 200 Principal component score datasets also produced
- All channels can be reconstructed from PCs – reconstructed data is noise-filtered
- All files in BUFR
- Retrievals will be available as soon as QC issues are resolved -- NWP customers are DAO and FNMOC.

NWP Distribution



NWP Customers

- NCEP
- DAO
- CMC
- JMA

- FNMOC
- BMRC

- UK-Met Office
- ECMWF
- Meteo-France
- DWD

Near-term new datasets

- Reconstructed radiances from PCA (322 channels)
- Cloud-cleared radiances (322 channels)
- Both files will be in same BUFR format
- Level 2 retrievals
- AMSR-E brightness temperatures

Offline system for monitoring/ validation

- Daily Global Grids (0.5 x 2.0 resolution) of
  - observed radiances (center fov)
  - cloud cleared radiances
  - principal component scores of above
  - retrievals from level 2 support file
  - NCEP and ECWMF forecasts
  - clear simulated radiances from NCEP and ECMWF

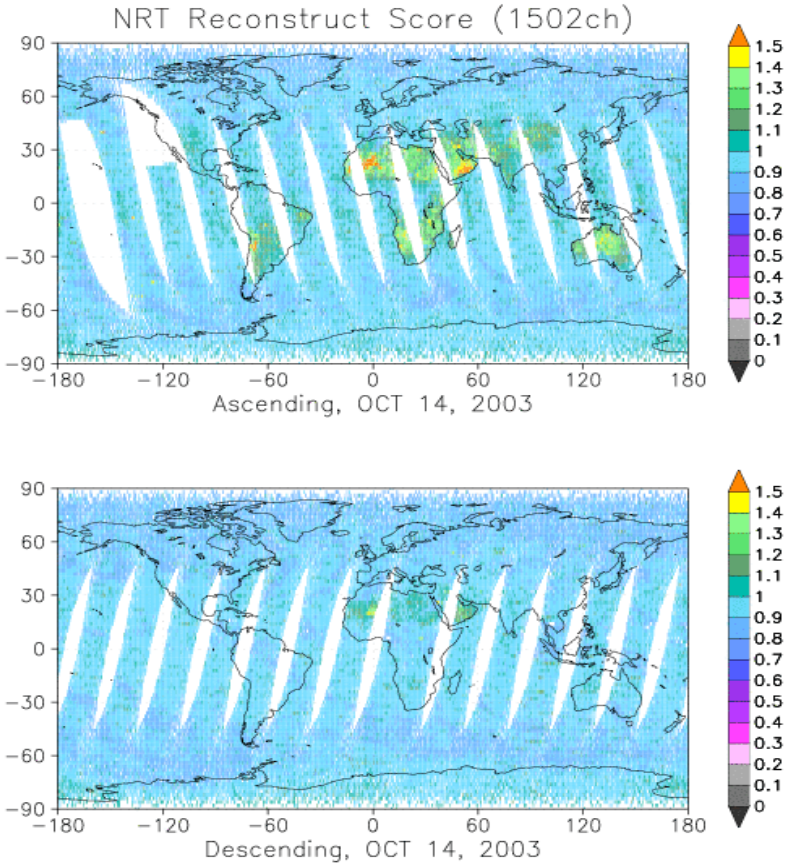
- NEW GLOBAL GRID > complete AIRS/AMSU Golfballs @ 3 x 3 resolution

- Radiosonde collocations

Reconstructed Radiances

- Based on July meeting – ECMWF will start evaluating reconstructed radiances
- The static eigenvectors have remained very stable
- Eigenvectors are based on 1502 channels – We are conducting a study to increase the number of channels to about 2000.

Radiance Reconstruction Scores Predominantly < 1



- Reconstruction scores > 1 are over hot ground, however because the nonlinearity of Planck function, these are region which has the best brightness temperature reconstructions.

Monitor Quality of AIRS Products

Level 1B
Observed Radiance
Cloud Cleared
Reconstructed
more...

EOF
Observed
Cloud Cleared
All FOVs
more...

Level 2
NOAA Regression
Team Retrieval
Regression (GB)
Hurricane Study...

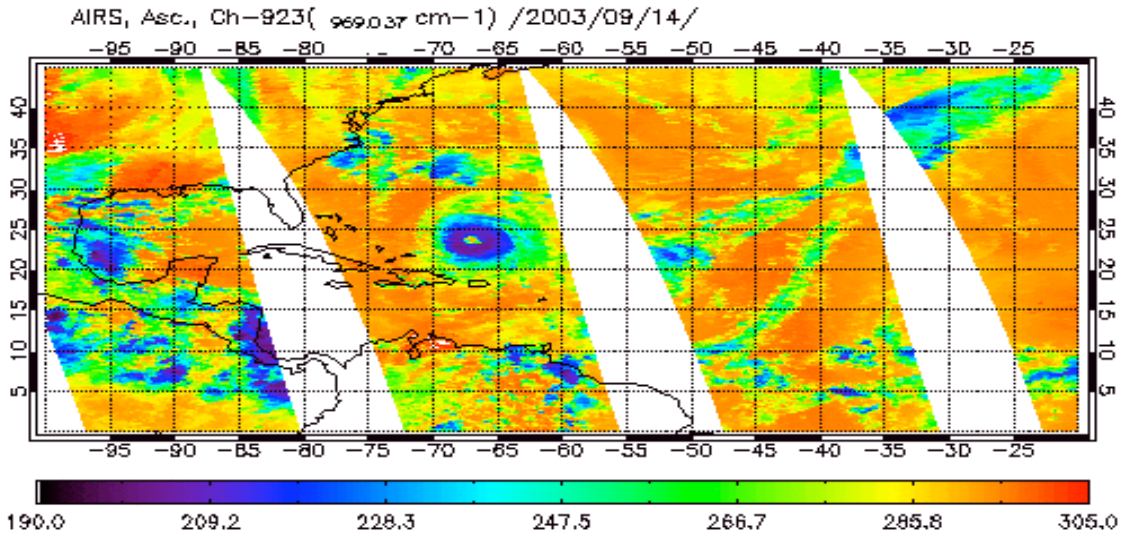
Monitoring
EDOS Transfer
Reconstruct RMS
more...

Documentation
PGE Interface
Channel Properties
Reconstructed
more...

Validation

Welcome to AIRS NRT Site At NOAA

Click to see more of ISABEL



The Atmospheric Infrared Sounder(AIRS) is the first high spectral resolution infrared sounder data to be routinely distributed to Numerical Weather Prediction (NWP) Centers in near real-time – generally within 3 hours from observation time.

AIRS is a cooled grating array spectrometer.
Spectral coverage 3.7 to 15.4 microns in 17 arrays with 2378 spectral channels.
Spectral resolution n/Dn=1200, 15 km FOV from 725km orbit.
AQUA was launched May 4, 2002.

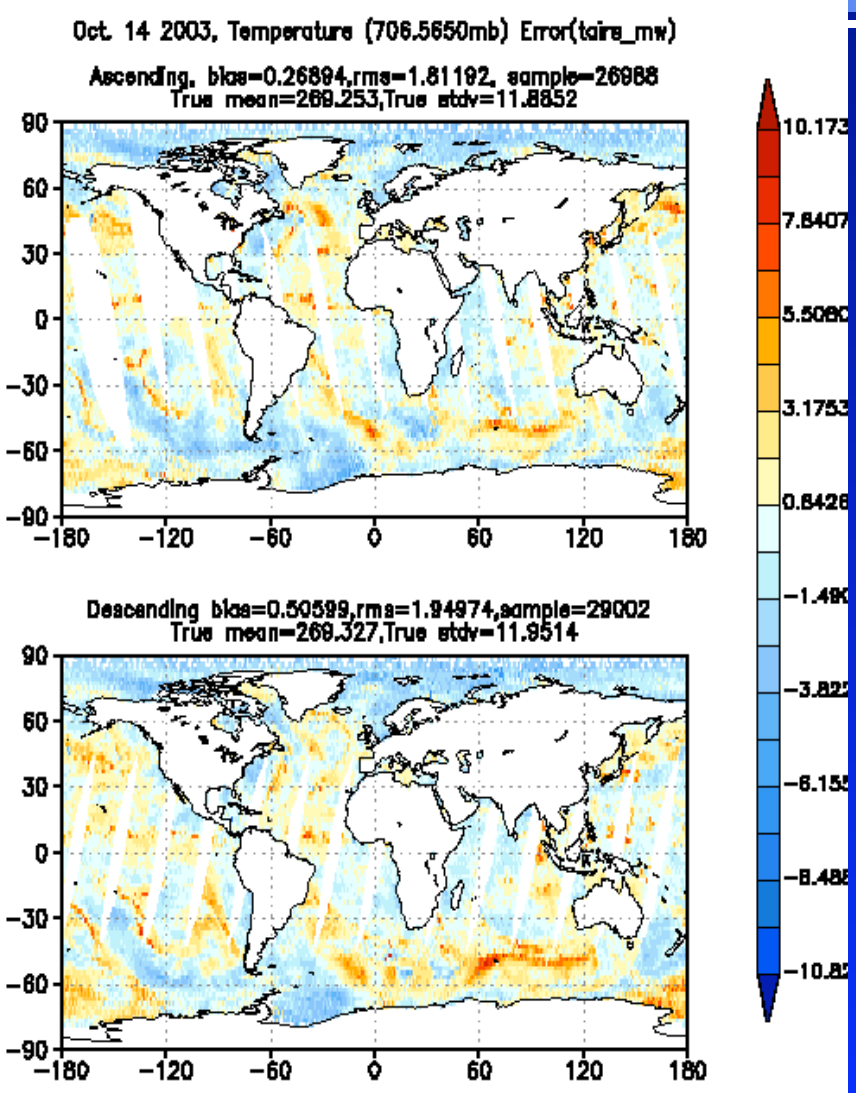
Primary products: temperature profile (< 1 K accuracy), moisture profile (< 15%) , ozone (< 15 % (layers) and 3 % total).
Accuracy is achieved in clear, cloud cleared, or above clouds. Algorithms developed by AIRS science team.
Details can be obtained from the AIRS science team website

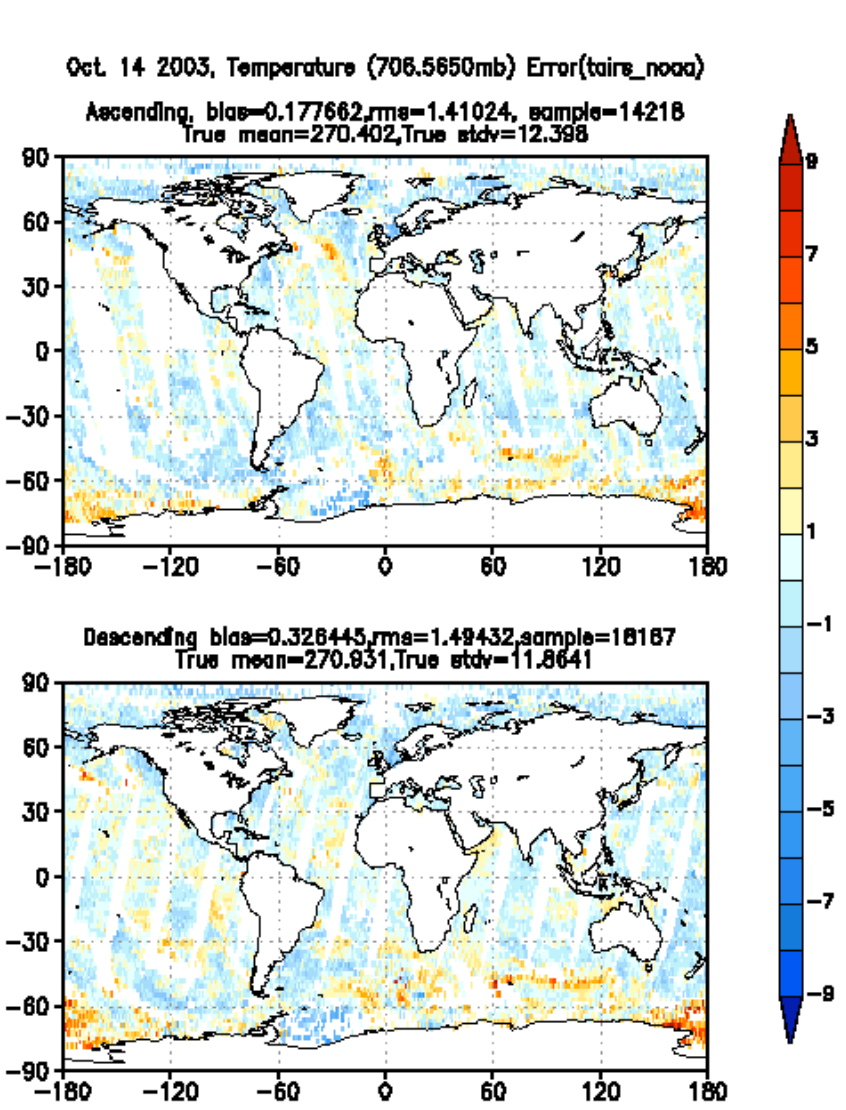
Daily products including Thinned Radiance files (HDF and BUFR): a) center AIRS fov within every other AMSU-A fov, 324 AIRS channels + AMSU and HSB (11 MB per orbit)
b) 281 AIRS channels + AMSU and HSB (8 MB per orbit) using same thinning as a)
c) Same as a) but with all 3 x 3 AIRS fovs.
d) Full resolution AMSU and HSB
e) 200 principal component scores using same thinning as a)
* all include cloud indicator

Results from Team Retrieval

Microwave only

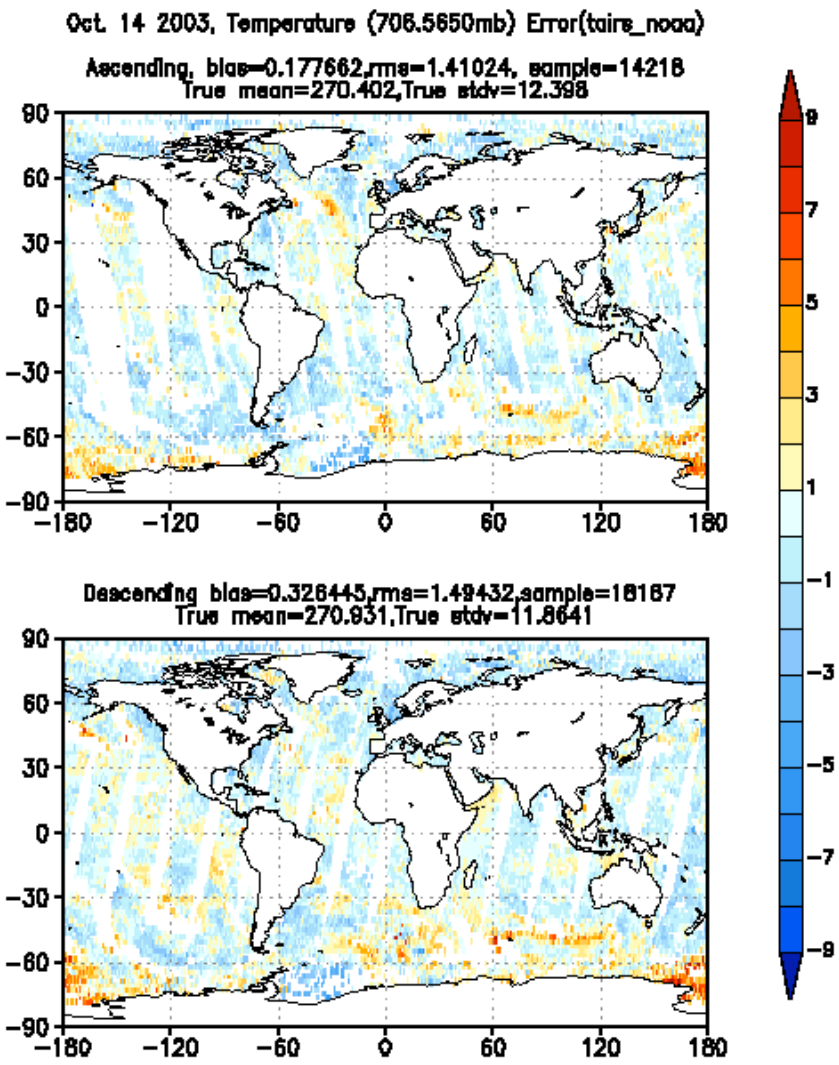
AIRS Regr only



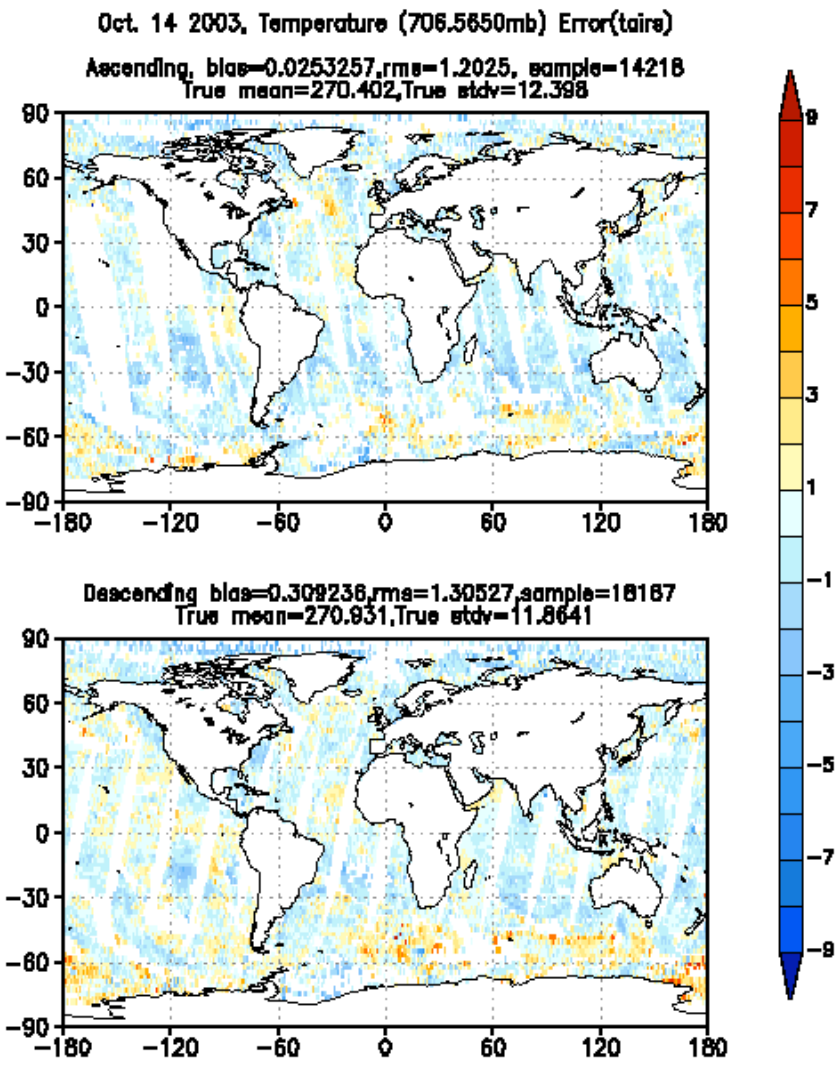


Results from Team Retrieval

AIRS Regression



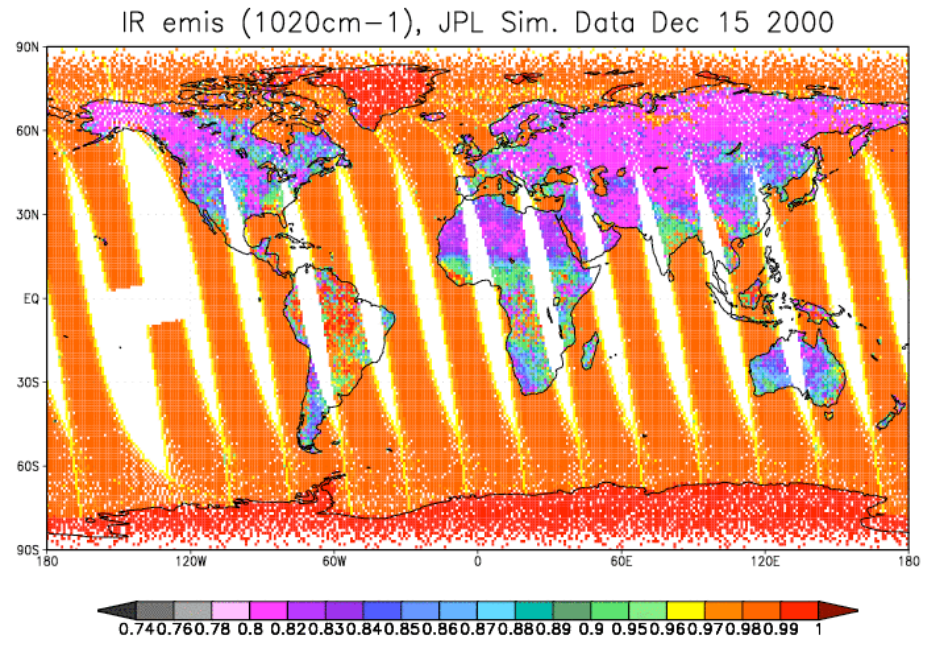
Final Retrieval

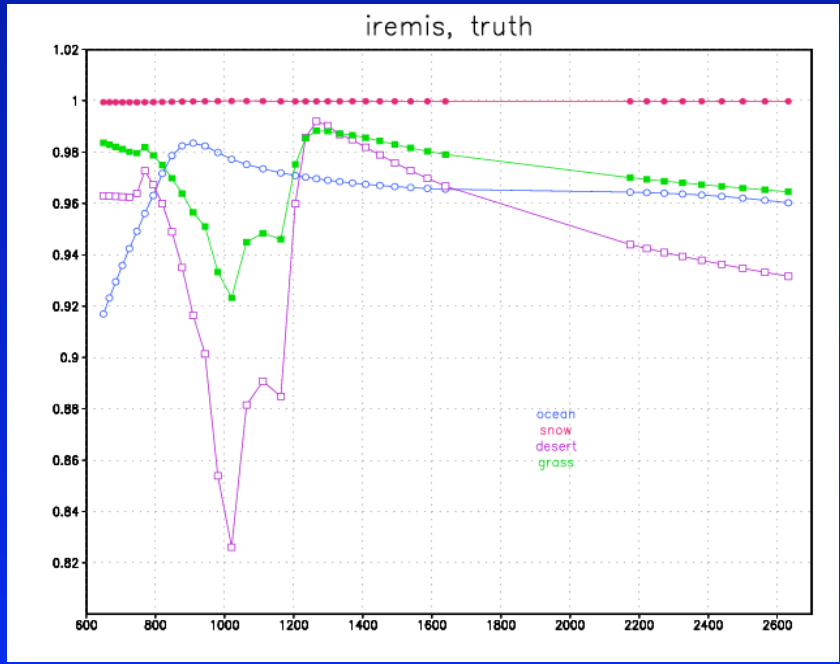


IR Emissivity Issues

- Problem found in emissivity regression due to training problem.
- Approach> Simulate clear radiances from the Dec 15 2000 training set created by Evan Fishbein. We use 18 window channels as predictors for each of the 39 hinge points.
- Mistake we made, was that we inadvertently used only locations that were specified clear by AVN model which limited the variability/ representativeness of the training. We should have simply ignored the clouds.
- So we regenerated coefficients, and now the results are much better.
- Improving the training set will also improve the results.
- Synthetic regression is currently the preferred approach due to lack of truth.

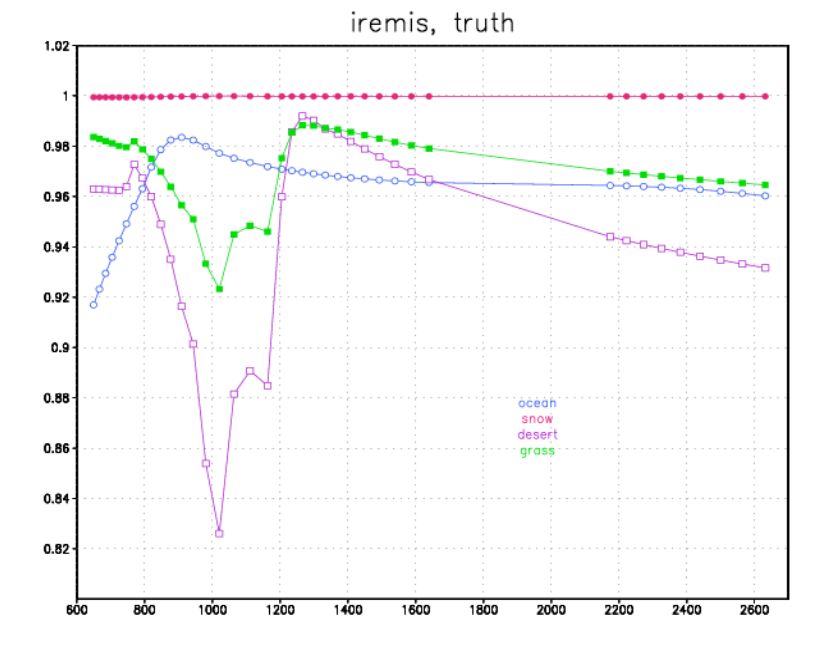
Emissivity from Simulation

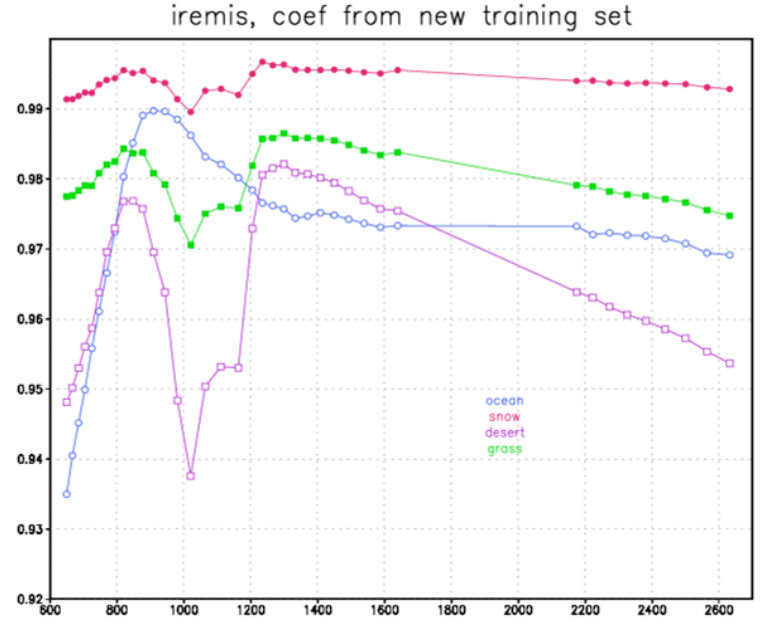




IR Emissivity Results

Mean emissivity spectra as a function cloud cleared radiances for 4 different surface types





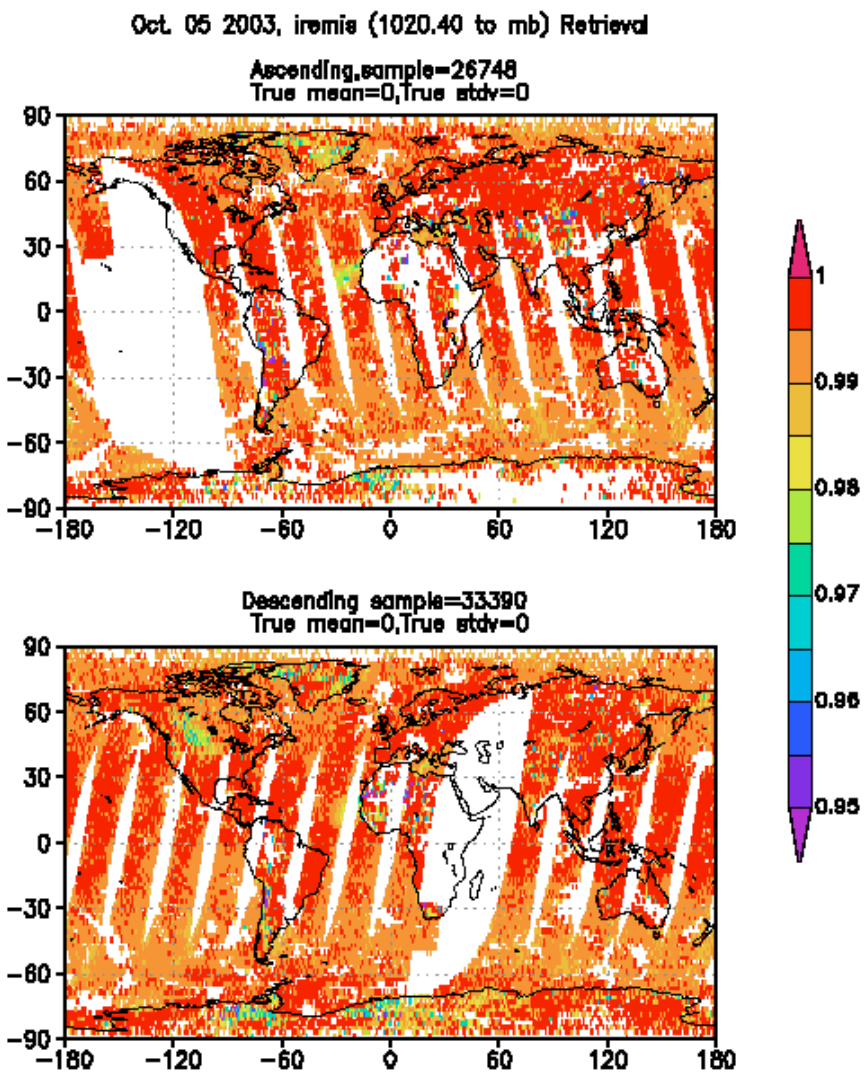
Ocean = average between 50 S- 50 N

Snow = 90S-80S

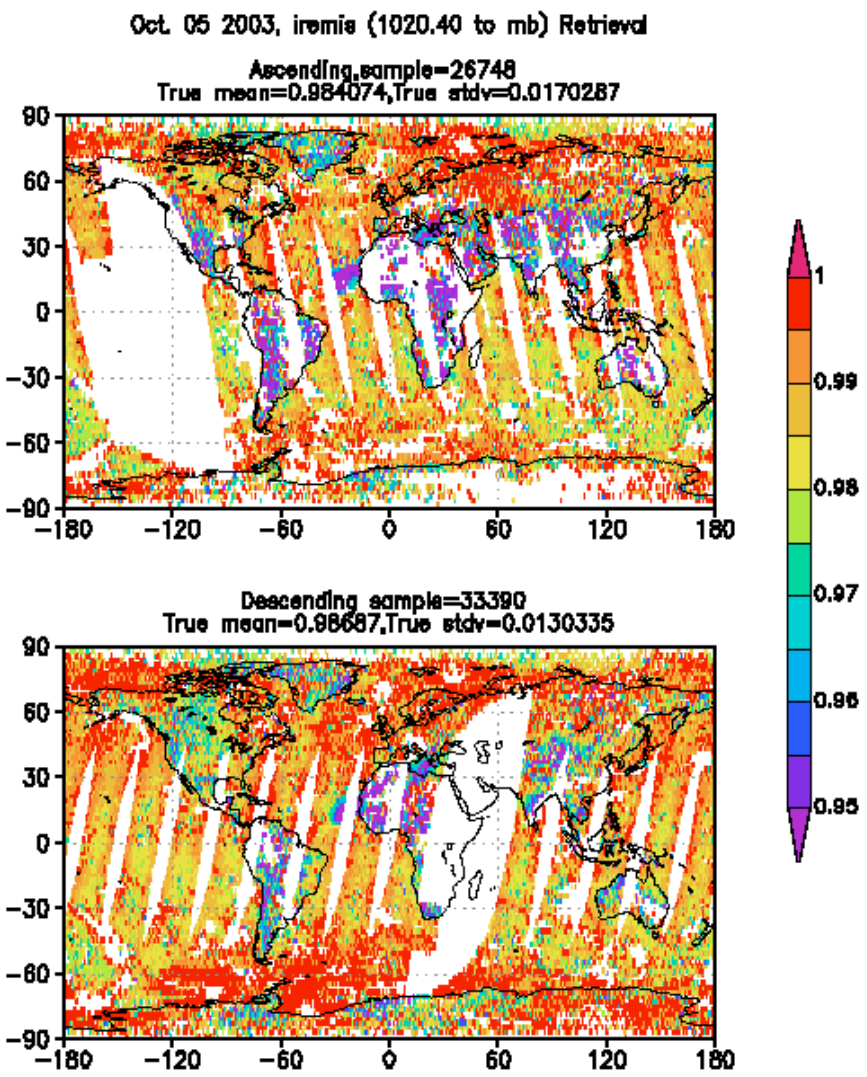
Desert = 0- 30E, 25-29N

Grass = 90W-80W, 30N-40N

Old coefficients



New coefficients



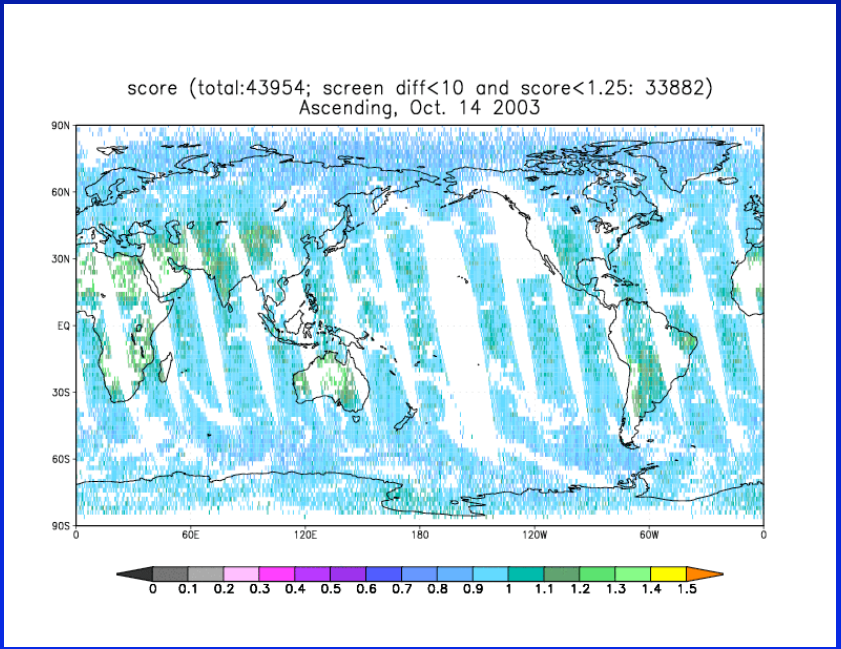
Collocated Radiosondes

Collocated Radiosondes

- Since October 02, AIRS Golfballs have been collocated to NESDIS NOAA-16 Matchup files
- Number matchups ~ 40,000
- Started experiments using the matchups to generate regression retrieval coefficients.

Regression retrieval experiments based on radiosonde collocations

- First removed very opaque mid-upper tropospheric clouds by using our test that predicts 2390 from AMSU channels 4, 5 and 6. (used diff > 10 for screening).



Exclude by 25% of the data

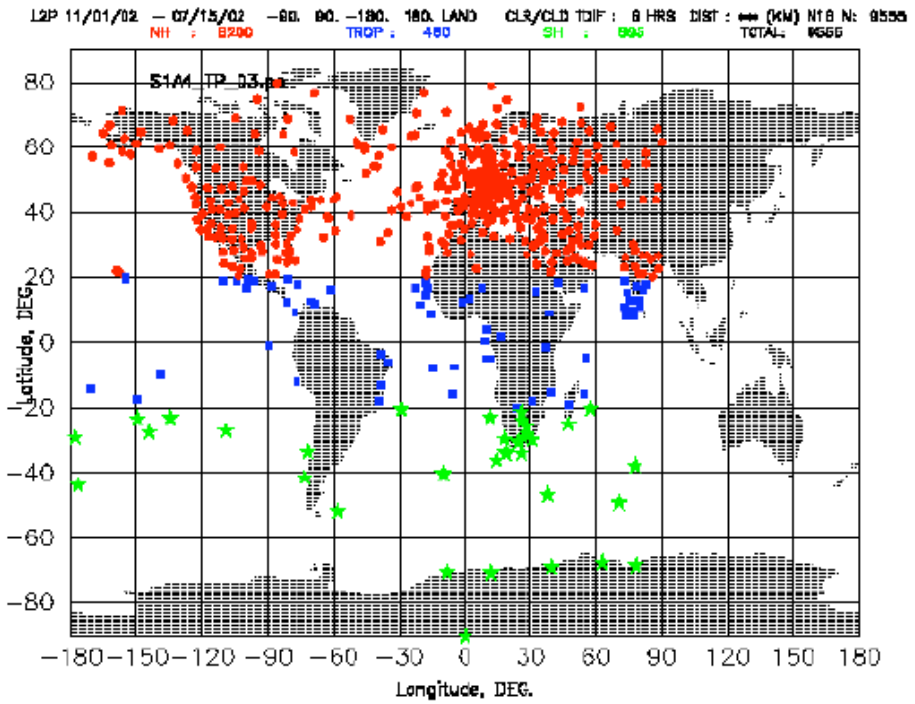
Regression retrieval experiment

- Used multiple cloud-contaminated AIRS fovs plus AMSU for predictions.
- Used fov 2, 5, and 8. (60 PCs from each fov, + 10 AMSU-A channels, + scan angle + side of scan. Total of 192 predictors
- Generated land/sea combined coefficients

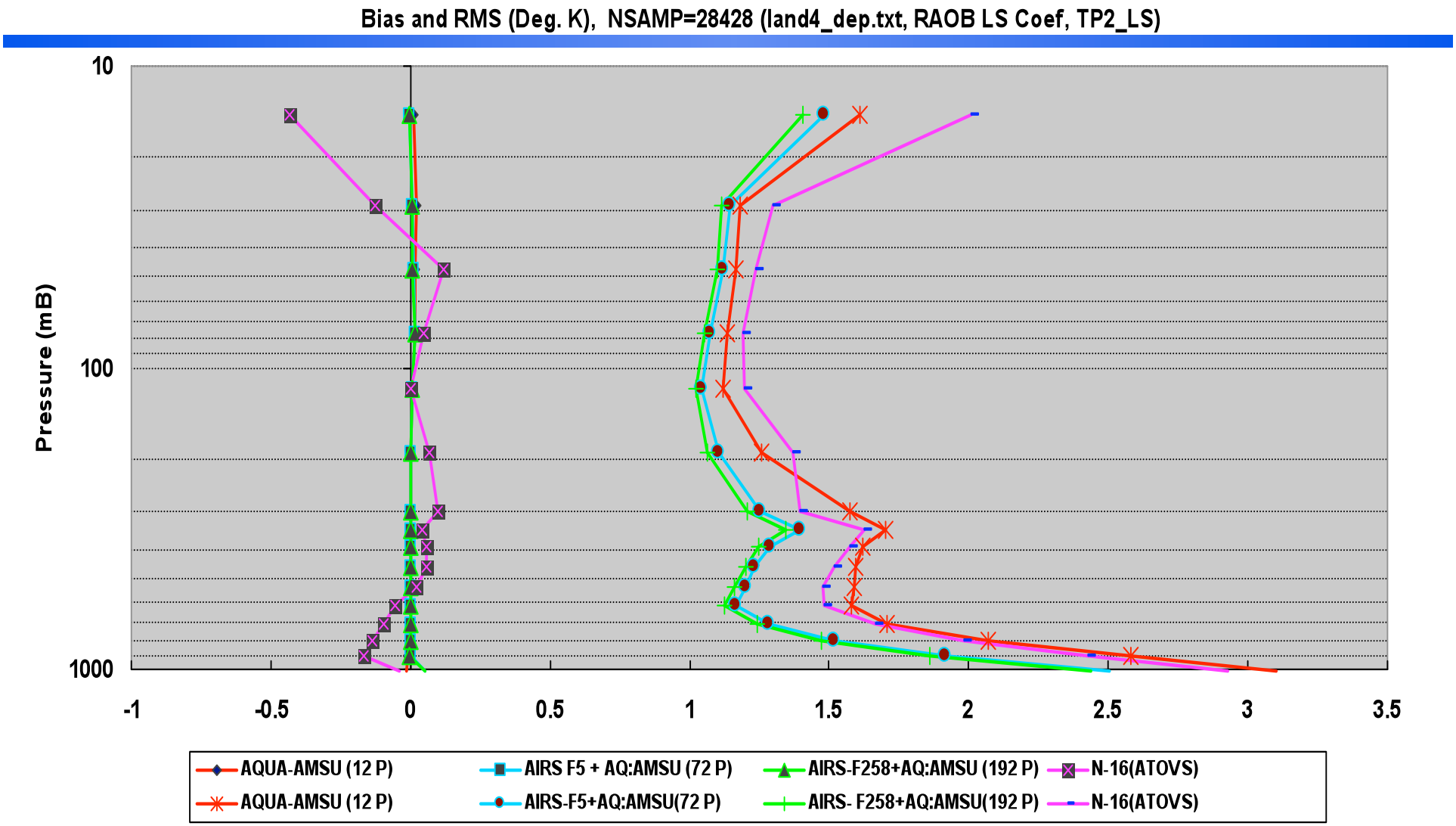
RAOB-AIRS Collocation Dataset Nov. 2002 – July 2003.

	Land and Sea	Sea
NH (20N-90N)	23820	1690
Tropical (20S-20N)	1628	362
SH (90S-20S)	2980	732
Total	28428	2784

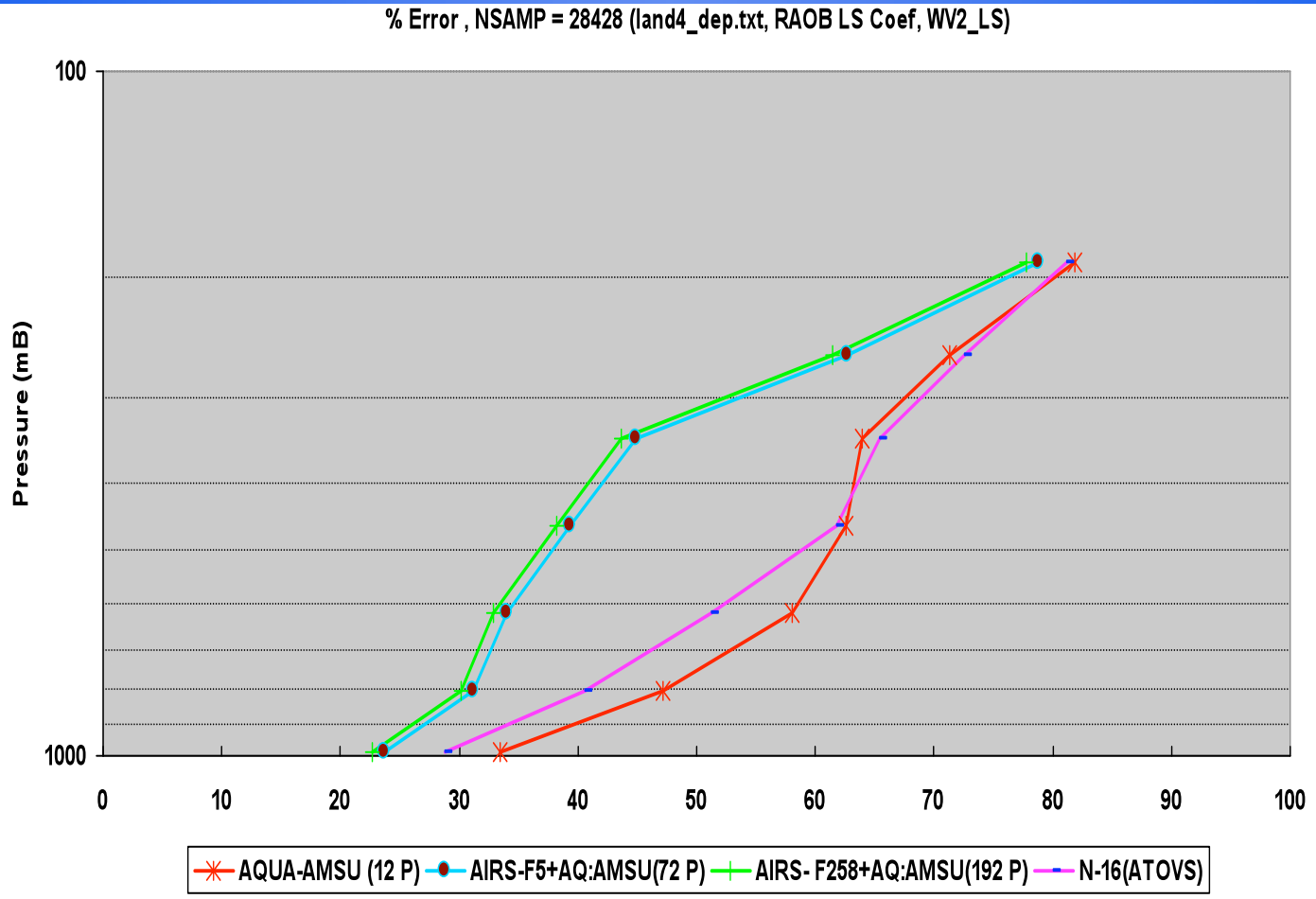
RAOB Locations (Land and Sea Samples)



Temperature Bias and RMS (All Land and Sea Samples) Without Cloud Test



Water Vapor Error (All Land and Sea Samples) Without Cloud Test



Samples used in Applying the Coefficients after gross Cloud Tests

	Land and Sea	Sea
NH (20N-90 N)	6745	635
Tropical (20S-20 N)	459	119
SH (20S-90 S)	1034	305
Total	8238	1059

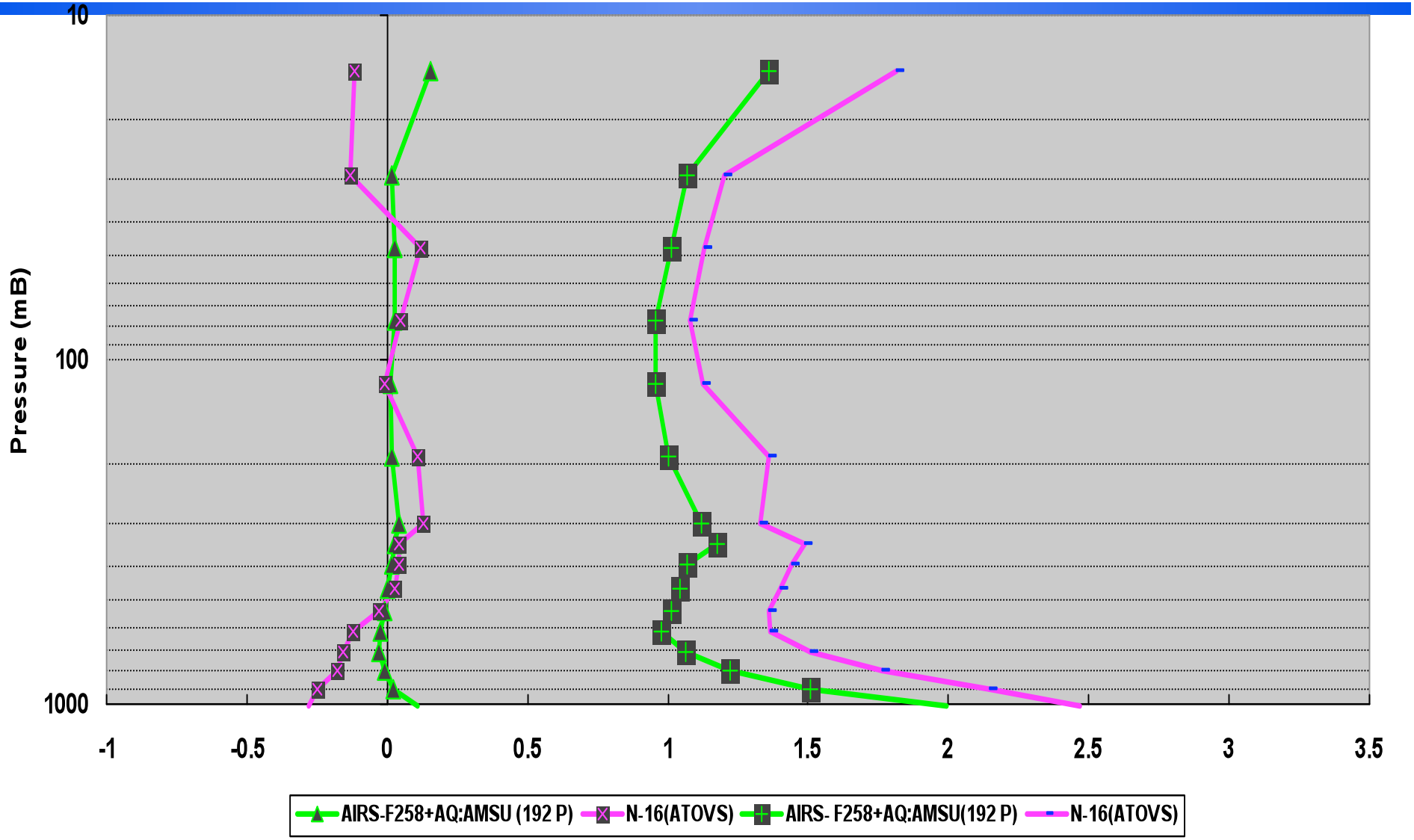
- Screen matchup data by requiring agreement between observed AIRS and raob calculated AIRS
- Selected 12 channels

  702.7 706.1 711 712.7 715.9 724.8
  746.0 759.57 965.4
  1468.83 1542.35 1547.88
- All channels < 5 K

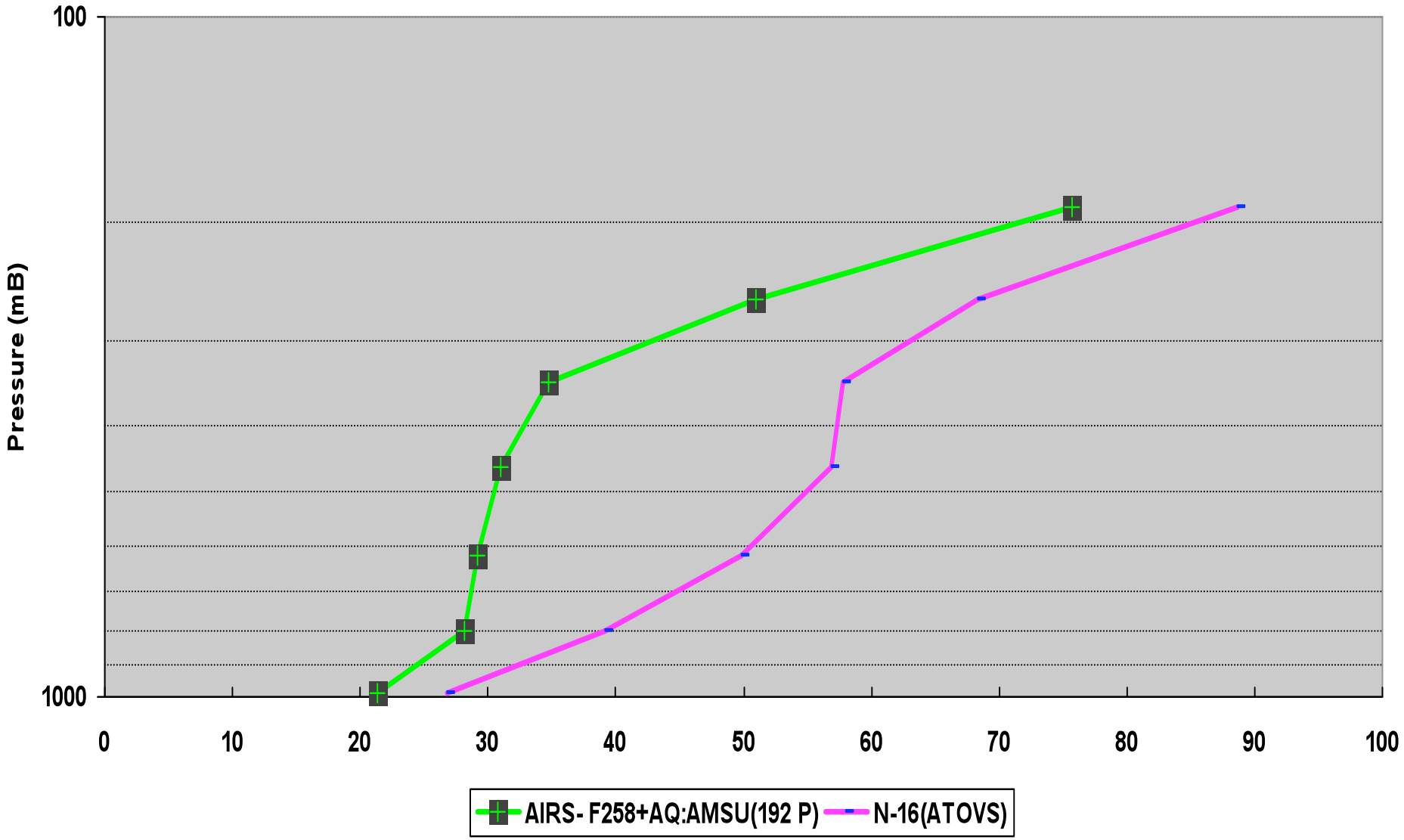
~20% of the data

Temperature Bias and RMS (Land and Sea Samples) With Cloud Test

Bias and RMS (Deg. K), NSAMP=8238 (land2_dep.txt, RAOB LS Coef, TP2_LS)



Water Vapor Error (Land and Sea Samples) With Cloud Test



Future Work

- Cloud clear collocated AIRS Golfballs
- Generate new regression coefficients.
- Above 10 mb, use synthetic regression
- Work to improve surface emissivity – better training
- Continue NESDIS validation of AIRS products (level1, level2)
- Continue to develop validation tools (global and granule)

Future direction

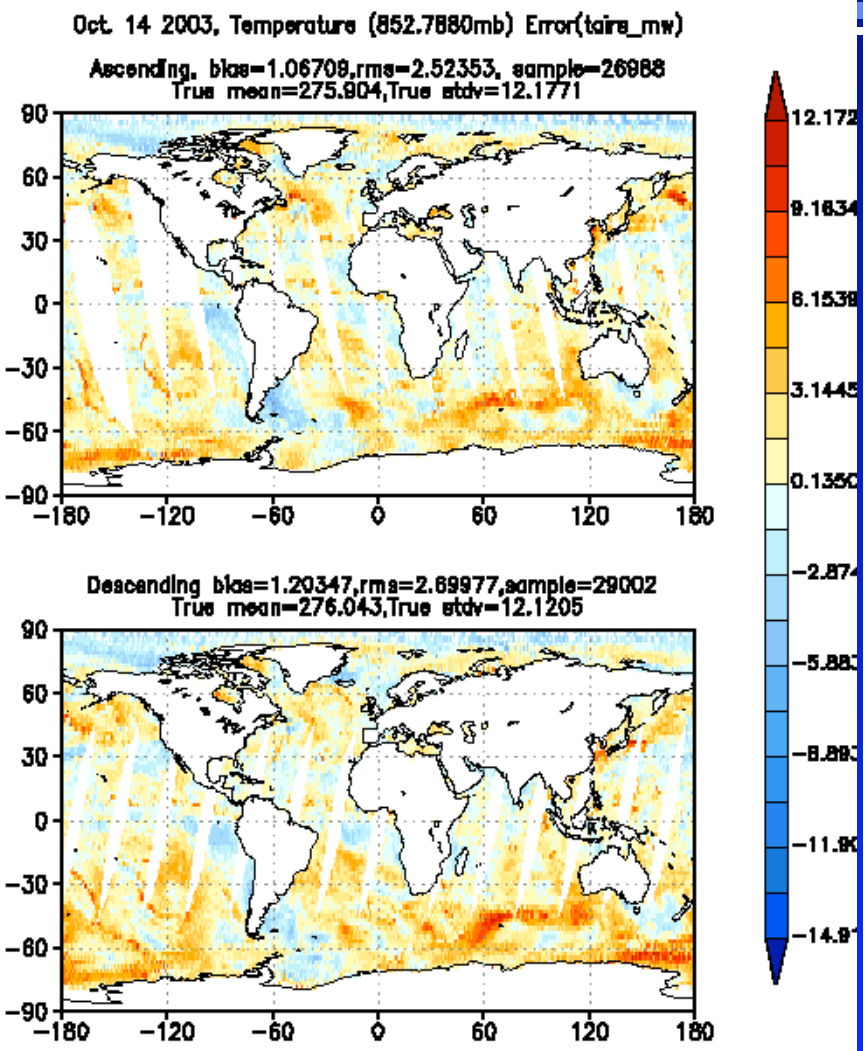
- AIRS is an important stepping stone for development of NESDIS operational IASI and CrIS processing systems
- The current AIRS processing system is the foundation.
- Improvements are needed throughout the system (e.g. cloud clearing, physical retrieval, qc, etc)
- We will make any necessary changes to meet NESDIS requirements for a stable, robust and accurate retrieval system.
- Lessons learned & discoveries will be documented and provided to the AIRS science team for consideration.

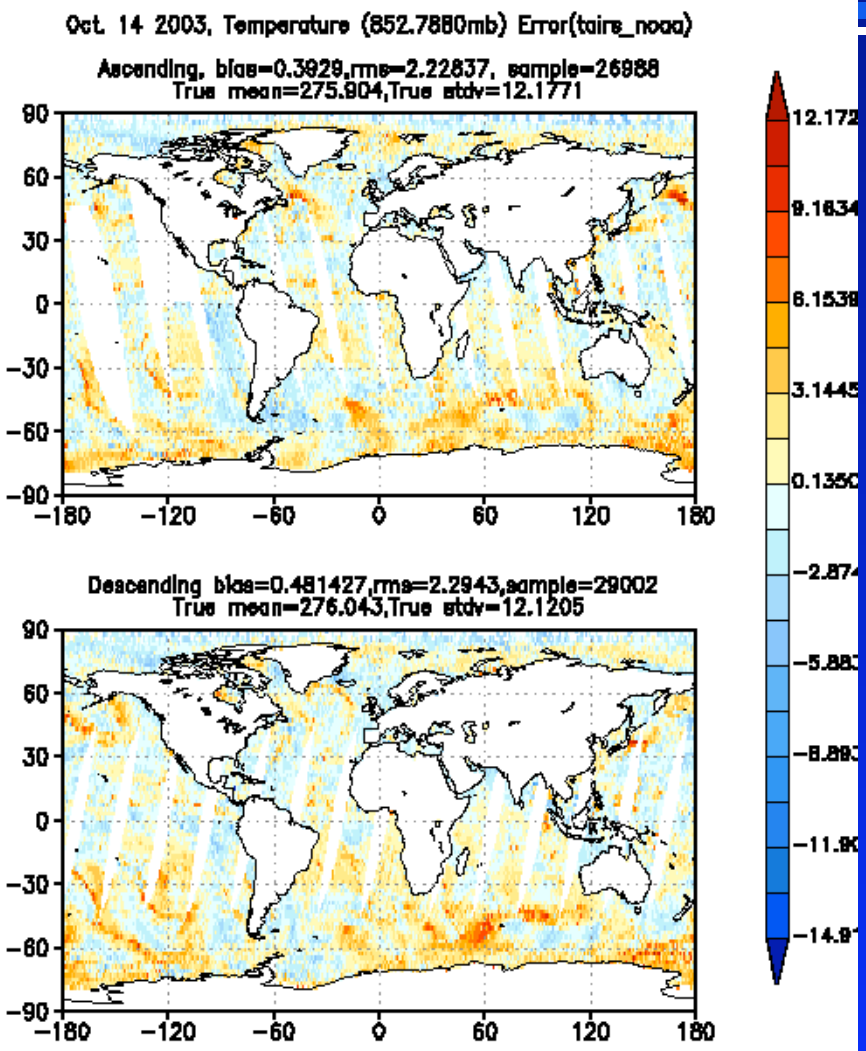
Backup slide

Results from Team Retrieval

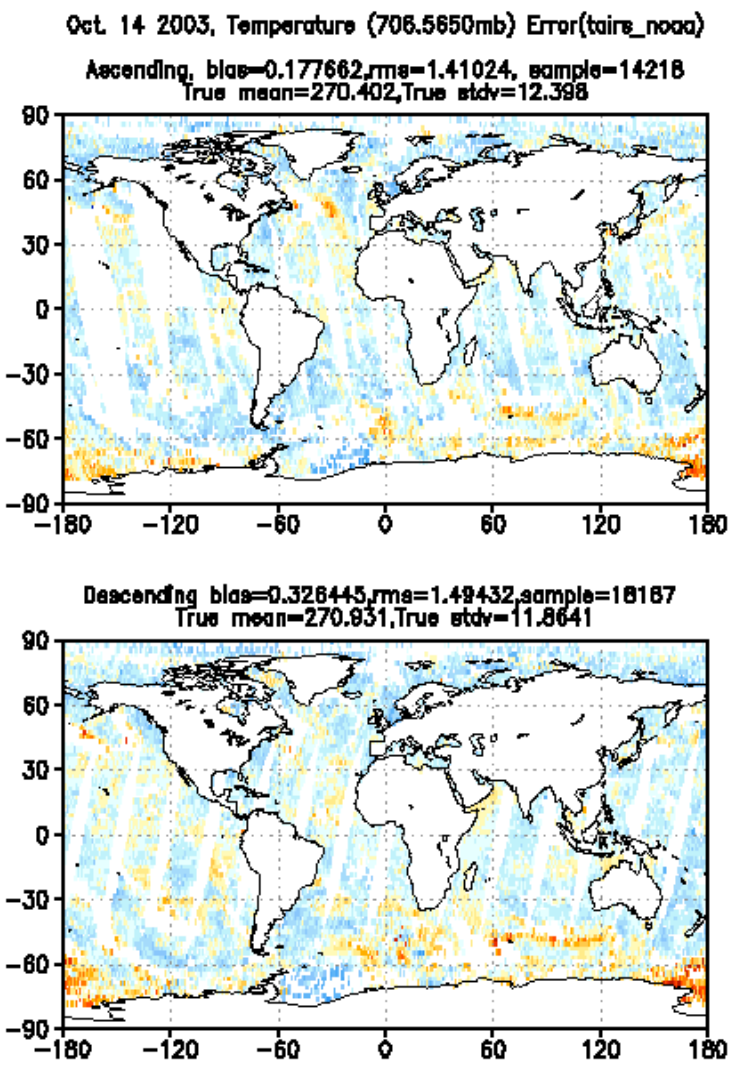
MW

Initial

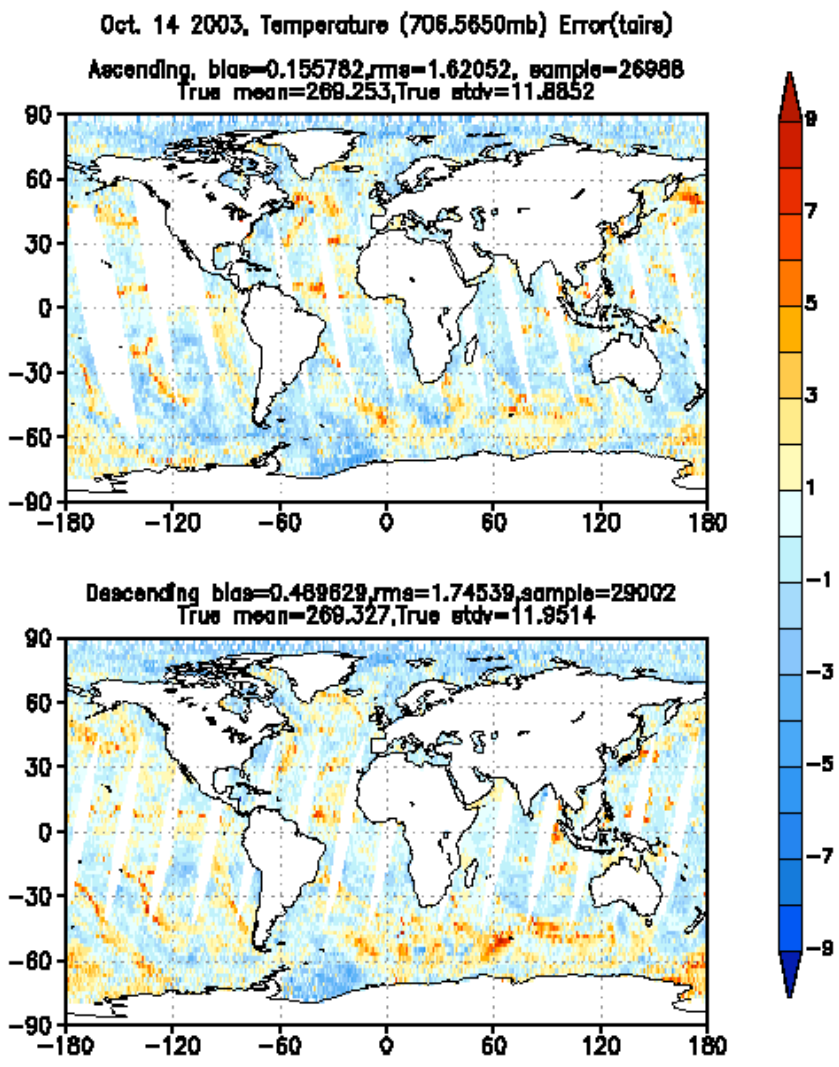




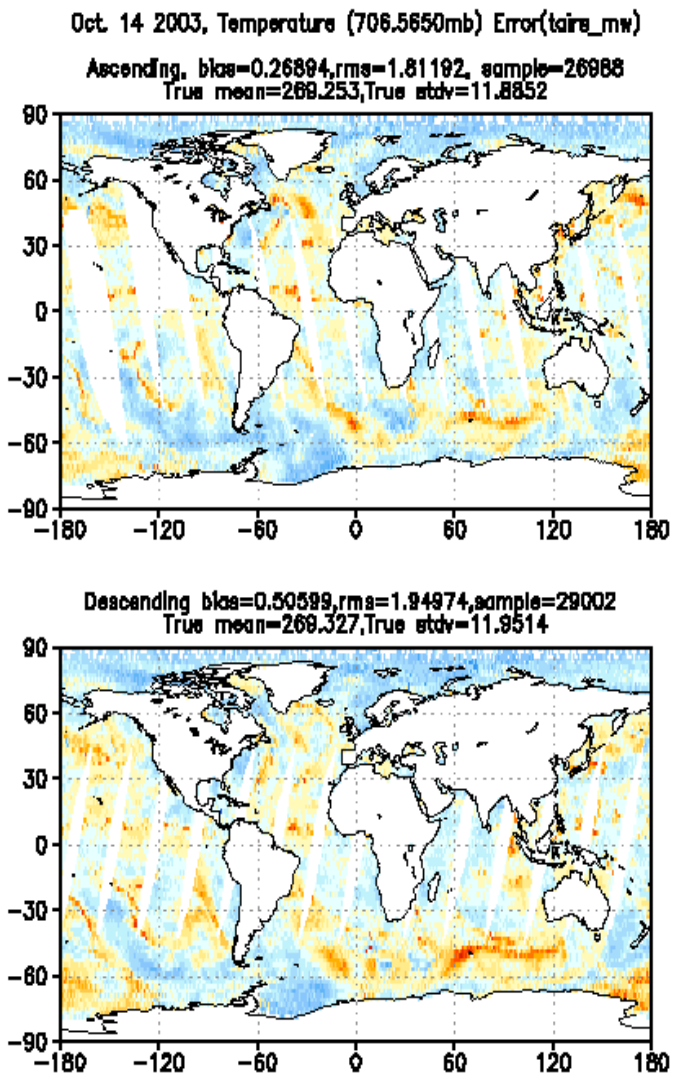
NOAA Only



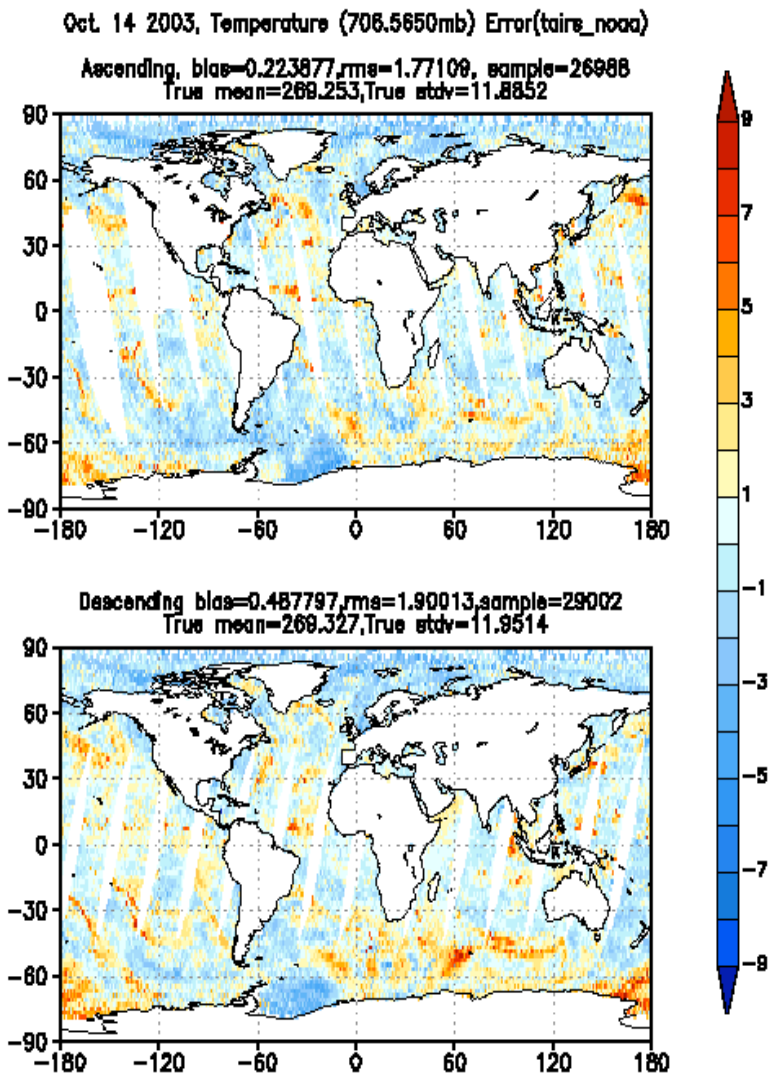
Final



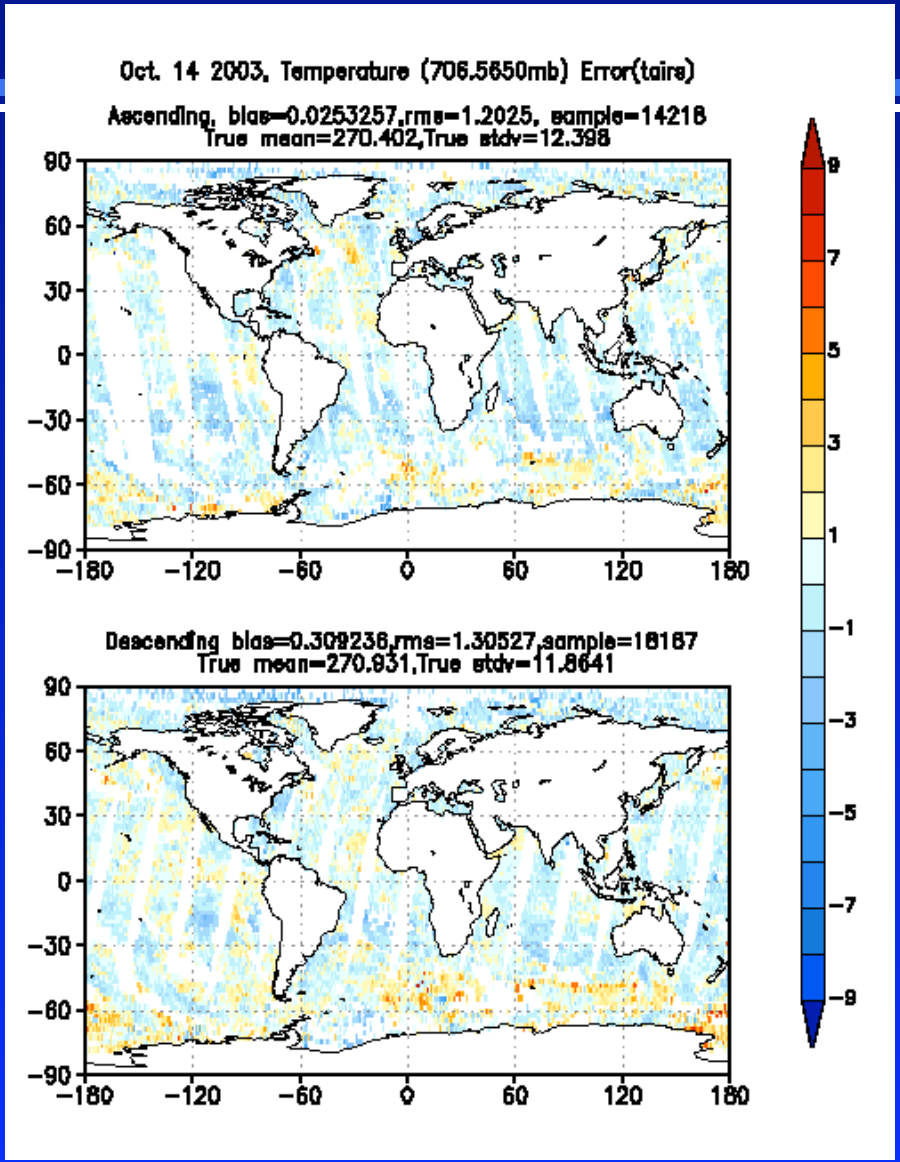
MW



MW and IR Regr



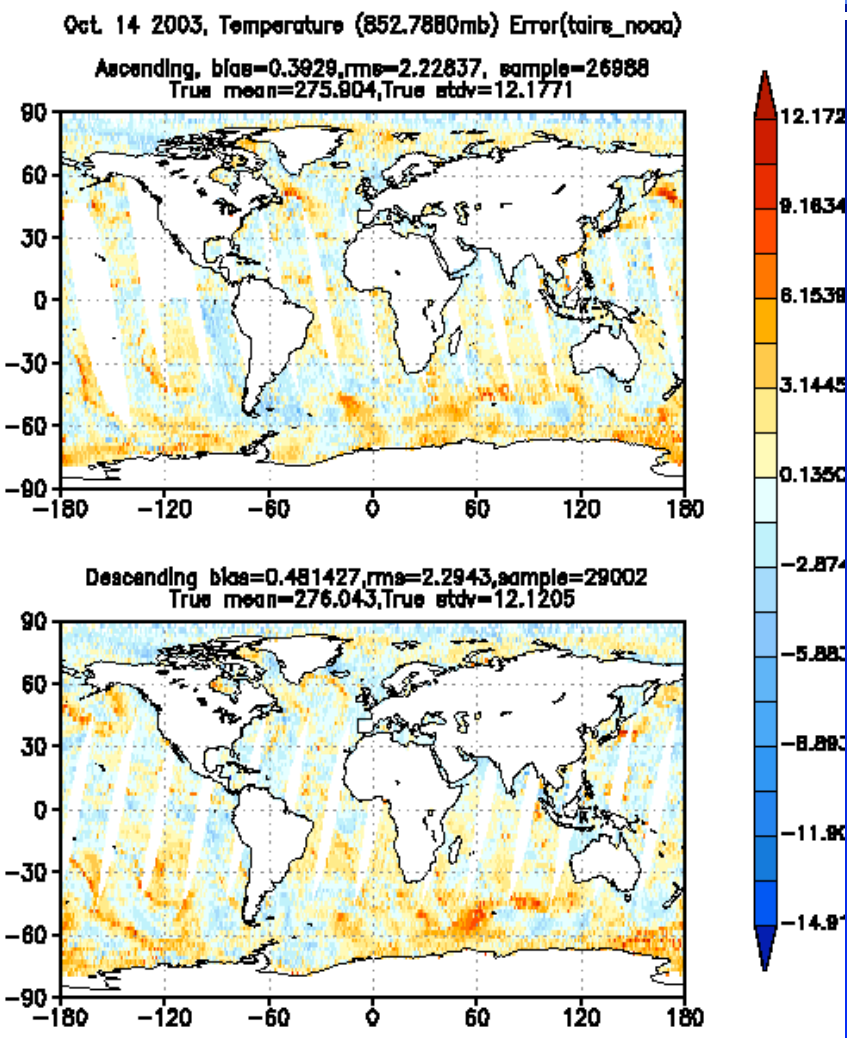
Final for where only NOAA passed

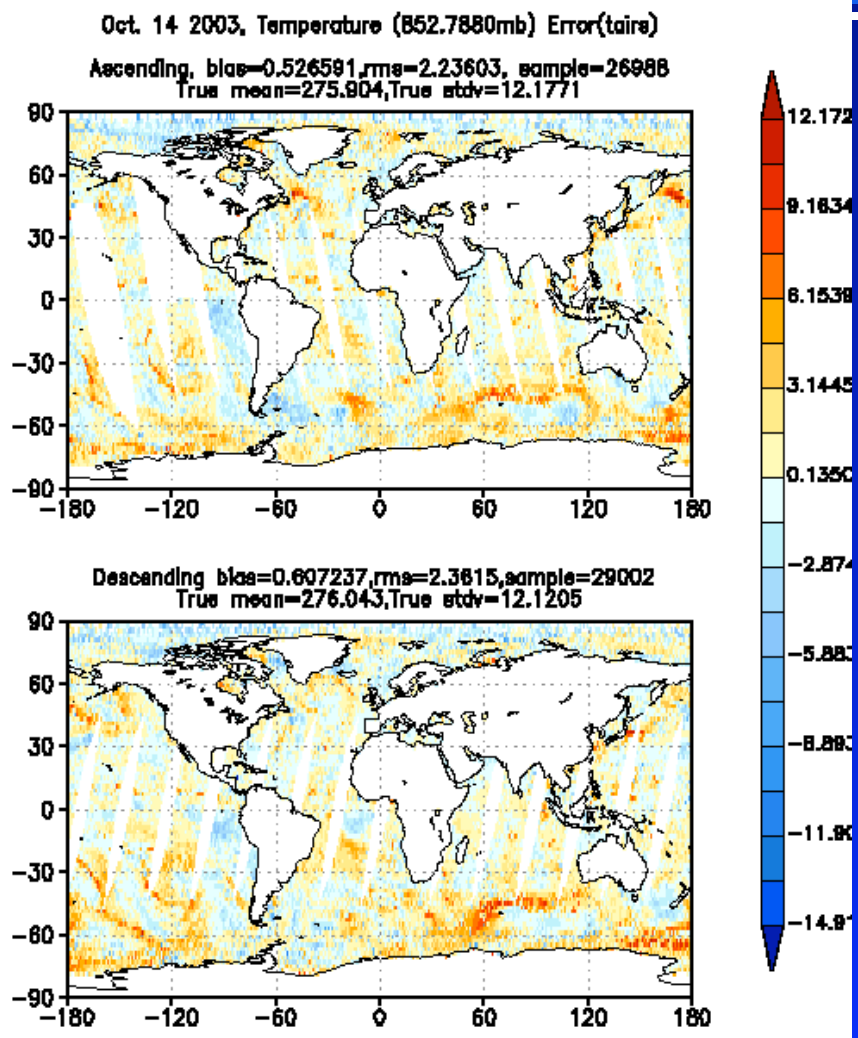


Results from Team Retrieval

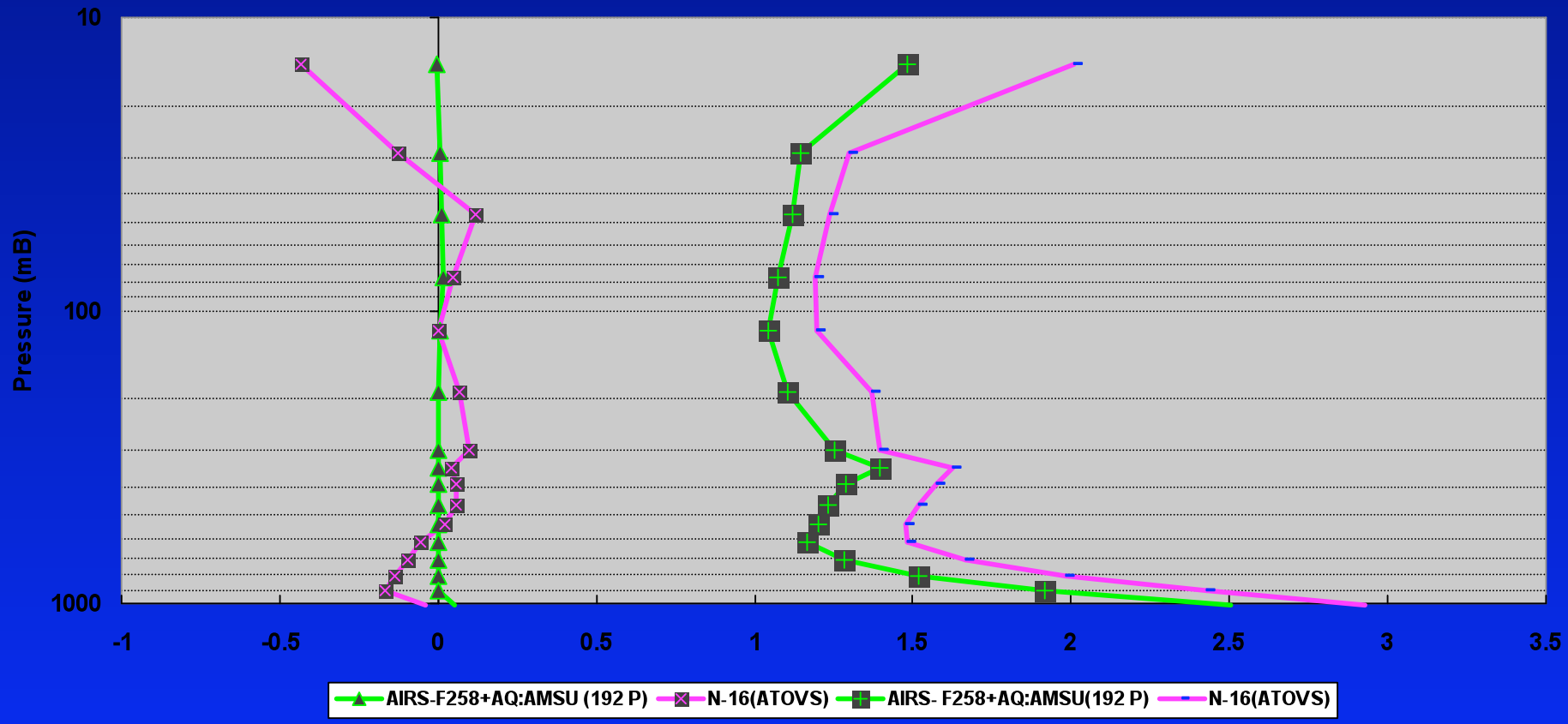
MW and Initial

MW and Final





Temperature Bias and RMS (Land and Sea Samples)



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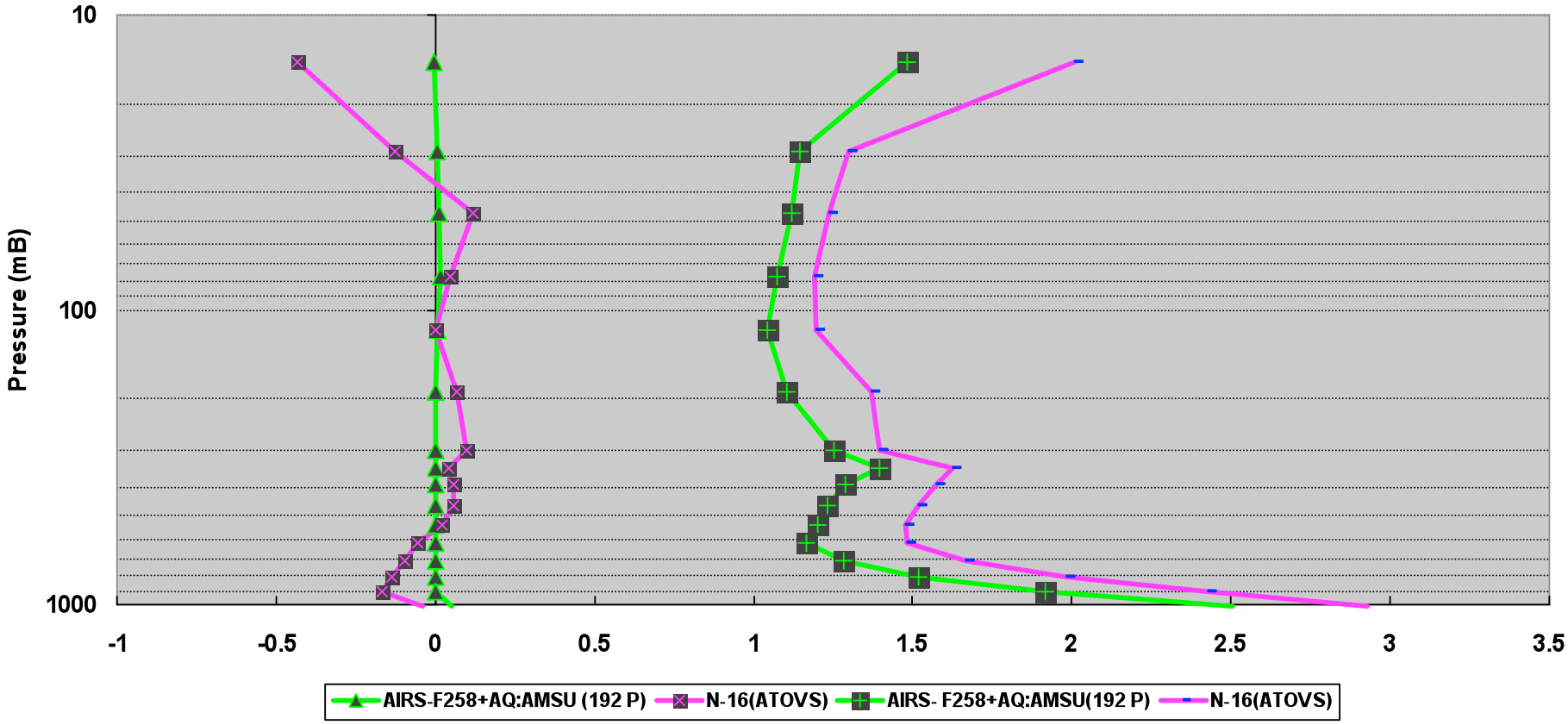
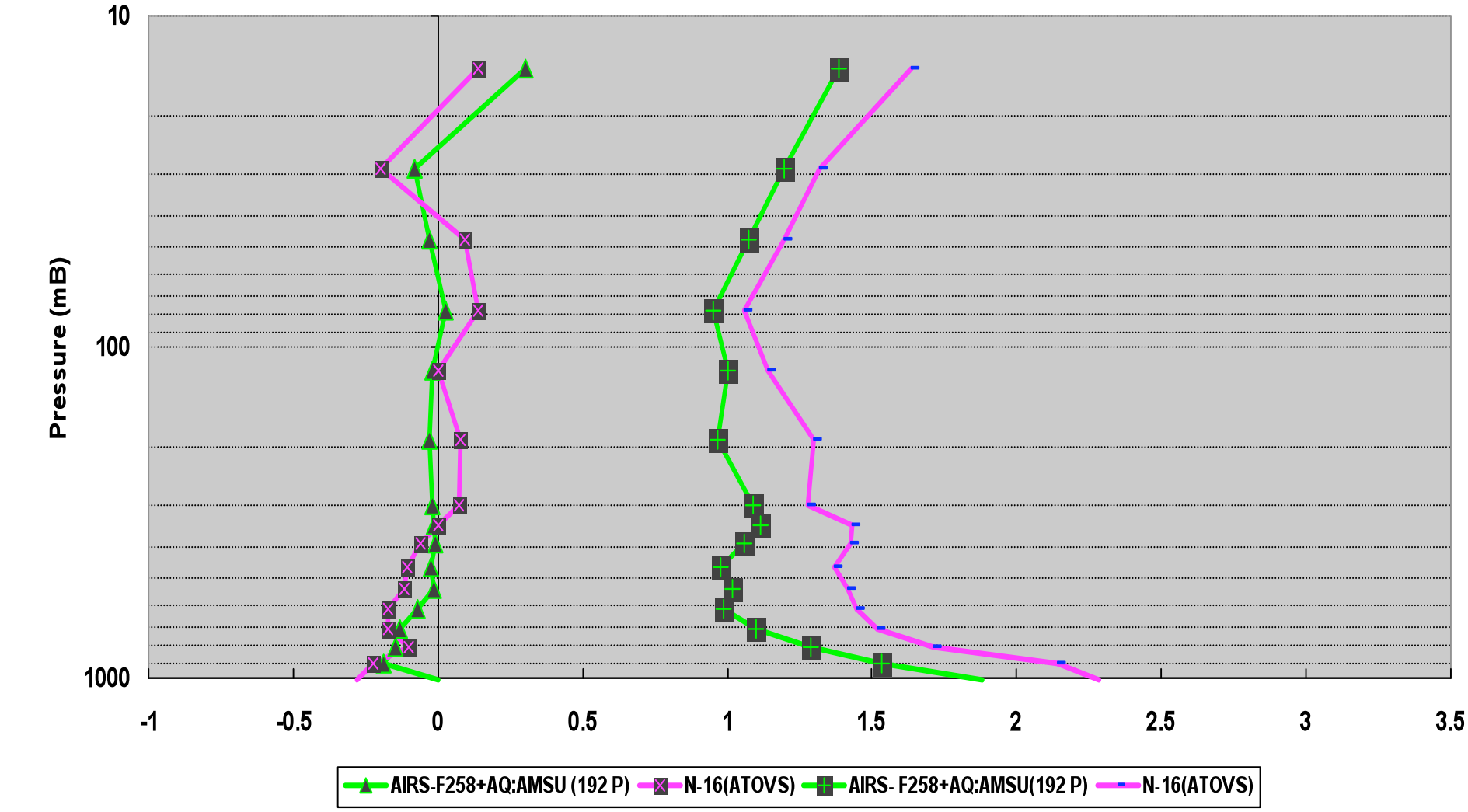
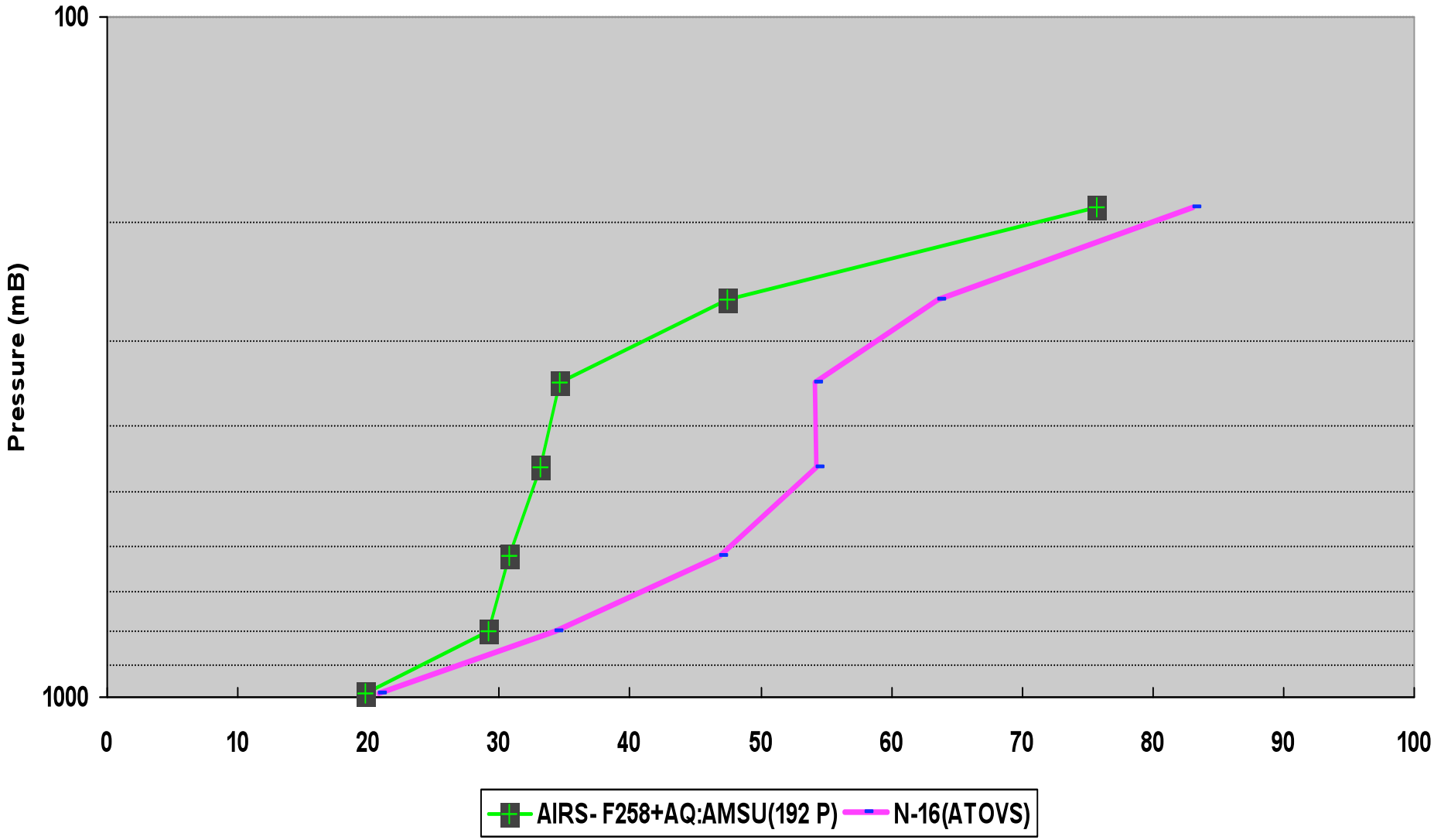


Temperature Bias and RMS (Sea Samples) With Cloud Test



Water Vapor Error (Sea Samples) With Cloud Test



RAOB Locations (Sea Samples)